LITTER AND SOCIAL PRACTICES

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INTRODUCTION

People have strong feelings about litter as it affects their views about the place they live. Removing litter is expensive and accounts for about £1 billion per year of public expenditure (HoC CLGC, 2015). This estimate does not include litter on land outside the control of municipalities nor does it include the vast quantity of litter that is never collected and becomes integrated with soils and seas.

According to the environmental charity Keep Britain Tidy, while only 28% of people admit to it, in fact around 62% of people have dropped litter (Keep Britain Tidy, 2013: 4). The real figures for litter deposition are probably even higher if unintentional or unknowing instances of littering are included, such as dropping a receipt or a morsel of food consumed 'on the go'.

This paper aims to provide a clearer conceptualisation by offering a new typology of litter (including marine litter), based around the ever-changing social practices that lead to its formation (Table 1). This typology is used to structure a review of the literature on prevalence and impacts of litter including its cumulative and single impacts and its environmental and human impacts. This new organisation of the literature on litter and the introduction of the social practices theory of change offer new insights into what kinds of approaches might be used to address the problem.

The paper draws from and updates the authors' previous work, including an evidence review commissioned by Defra, on ways of tackling low standards in local environmental quality (Davoudi and Brooks, 2012) and a think piece arguing for social justice in policy on littering (Brooks and Davoudi, 2013). We conclude with some reflections on the contribution that could be made to litter policy by theories of social and societal change, suggesting in particular that more attention is paid to the promotion of wider pro-environmental attitudes as part of tackling littering and a greater consideration of social justice.

TYPES OF LITTER, THEIR PREVALENCE AND IMPACT

What is litter?

The Environmental Protection Act 1990 (s.87) defines litter as "anything that is dropped, thrown, left or deposited that causes defacement, in a public place". This includes a wide range of items such as smoking-related litter (cigarette ends and packaging), chewing gum, food and drink litter (especially fast-food packaging), drug-related litter (such as used syringes), carrier bags and faeces (especially dog fouling). Without stretching the definition, we can include within this category a type of litter that is only beginning to gain public awareness – personal hygiene items, such as cotton buds, unthinkingly disposed of through the sewerage system, then accumulating as litter in marine areas.

Largely excluded from this definition, however, are other kinds of 'environmental incivility' such as fly-tipping (the illegal deposit of larger items of waste, ranging from black-bag waste through to large-scale dumping of industrial materials), addressed under s.33 of the Environmental Protection Act), as well as fly-posting and graffiti. These problems are nevertheless touched upon in the subsection below on the cumulative impacts of litter in combination with other environmental blights.

The research on littering and its remedies is patchy, with some categories (for example, those of reputational and economic concern to industries) far better represented than others (for example, dog fouling). Much research dates from an early era of consumer packaging and waste in the 1970s and 1980s, prior to the rise in today's most prevalent forms of littering. Those phenomena at the edge of our concept of littering, such as marine accumulations of litter that has entered the fluvial system or personal hygiene products flushed through the sewerage system, have only recently come onto the research agenda.

It is possible to break down litter in a variety of typologies, some of the most obvious being based on location (e.g. town centre, roadside, countryside and rivers), type of material (e.g. paper, plastics and organic), biodegradability and toxicity.

The typology used in this paper, and shown in Table 1, broadly situates litter according to its main (or major) associated social practices, each of which has its own material infrastructure,

Table 1: A typology of litter and its related social practices

Type of litter	Examples	Social practices
Waste food	Dropped and abandoned food and drink	Eating 'on the go' (seated out of doors or in a vehicle, walking)
Food packaging	Fish and chip wrappers, polystyrene foam boxes and cups, plastic bottles, glass bottles, coffee containers	Buying food from fast-food outlets to be consumed 'on the go' (seated out of doors or in a vehicle, walking)
General packaging	Carrier bags, polythene wrappers, paper bags, cardboard boxes, polypropylene straps, polystyrene filling, rubber bands	Opening/accessing/using various goods and printed materials 'on the go'.
Waste printed ticketing	ATM receipts, train and bus tickets, parking permits, betting slips	Issuing records of commercial transactions taking place outside the home of which the validity or usefulness is time-limited
Waste printed information	Flyers, newspapers, magazines	Distributing and/or consuming printed materials 'on the go'
Cigarette waste	Cellophane wrappers, boxes, cigarettes, cigarette stubs	Cigarette smoking on threshold or in vicinity of work and leisure premises, partly due to the indoor smoking ban
Chewing gum waste	Adhesive gum, gum wrappers	Consuming gum for breath-freshening, oral hygiene or confectionery, used as an accompaniment to outdoor activities
Dog waste	Dog fouling and discarded dog waste bags	Dog walking in public places, letting dogs run off the leash (out of an owner's sight), wishing to clear, but not to carry, waste.
Drug-related waste	Used syringes, drug residue on foils	Consuming drugs with fellow users, in parks or derelict/abandoned spaces
Personal hygiene-related waste	Cotton buds, feminine hygiene products, prophylactic devices	Using sewerage system as a disposal chute for personal hygiene products
Miscellaneous	Lost or abandoned property, discarded garden/waste	Dropping clothing, deliberately disposing of items unsuitable for household waste collections, disorderly or street lifestyles, criminal activity.

Sources: Davoudi and Brooks (2012); INCPEN (2014); authors' own typology and additions

cultural associations, range of participating agents, and interaction with wider social changes – for example, longer journeys to work and widening of participation in the labour force.

In order to fully appreciate the social practices and policy implications of the typology of litter, discussed in the final section of this paper, it is worth first considering the prevalence and impacts of each litter type identified in Table 1. The main research evidence for this is explored below.

Prevalence and impacts of litter

The effects of littering can broadly be divided into single and cumulative, and further subdivided into human and environmental impacts. While there will clearly be overlaps, it is helpful to look at each category in turn.

Human impacts

The human impacts of littering are probably better appreciated than their environmental counterparts. Although awareness of the environment has increased considerably over the past four or five decades, information programmes about litter impacts are only just beginning to target people's concern for the wider environment (e.g. Wiltshire Wildlife Trust, 2008) rather than being purely focused on issues around human wellbeing. The following section explores the research evidence on the human impacts for those types of litter outlined in Table 1 where research evidence has been identified.

Waste food: Research on the impact of food as litter links it with the attraction of scavengers that present a danger to human communities, in particular as carriers of diseases. A rising threat comes from airborne scavengers, such as gulls, that have been shown to gain health and breeding advantages from littered food (Stiegerwald et al., 2015) and contribute risks of contamination of surfaces and swimming waters with bacteria harmful to humans through their faeces (Reagan et al., 2012). Anecdotally, they may also graduate from litter forays to target food held by people eating out of doors (Horton, 2016).

Food packaging: Of all types of litter, food and drink packaging is the one that has grown at the fastest rate in many countries (Roper and Parker, 2013). Over the first decade of the Keep Britain Tidy surveys to 2011, its prevalence increased by 20% (Keep Britain Tidy, 2012a: 45).

The INCPEN survey (2014) found that food packaging and food made up 16% of total litter in its survey sites, and of that the largest component was made up by litter from confectionery.

The same survey, counting drinks-related items separately, found that non-alcoholic drinks-related items made up 9% of recorded litter, while 2% was accounted for by alcoholic drinks related items (INCPEN, 2014).

Residues of food on packaging can attract scavengers, as noted above, while cumulatively, food packaging contributes to an impression of neglect that can attract other kinds of blight. This area of littering is of interest not only to academics concerned with waste, but, in its branded form, to those concerned with marketing and the impact of discarded packaging on brand perceptions. There is some evidence that seeing clearly-branded packaging discarded as litter can detract from people's perceptions of the brand (Roper and Parker, 2006; Roper and Parker, 2013; Keep Britain Tidy, 2013: 11).

General packaging. This includes packaging for miscellaneous items that are not comestibles or cigarette-related and includes waste arising from the transport and storage of materials such as cardboard boxes, polystyrene filler and polypropylene strapping. Perhaps the most prevalent form of packaging litter is represented by the carrier bag, generally of a lightness that means it is easily transported by the elements, into both countryside (HoC CLGC, 2015: 9) and water systems. As such, it can be hazardous to animals and wildlife.

Cigarette-related litter. The INCPEN survey echoes the ENCAMS (now known as Keep Britain Tidy) on-the-ground surveys of local environmental quality, showing that cigarette-related litter, at 35.2%, is the most prevalent kind in England and has been since the survey began in 2001/2. While cigarette litter actually declined in 2008, which was the year after the indoor smoking ban came into force (Keep Britain Tidy, 2012b), this was a blip coinciding with a campaign that year against cigarette litter, and in subsequent years there were strong rises. It is safe to conclude that the laws against smoking in public indoor environments have increased the prevalence of litter from smoking. This fits with the experience from countries that have had the ban for longer, such as Australia, Scotland, Ireland and America.

Cigarette stubs are buoyant and easily enter water systems, leading to accumulations in beaches and coastal areas, where cigarette litter makes up around 28% of items (Schnieder

et al., 2011). Besides being unsightly, cigarette litter has been proven harmful to natural organisms (see section on Environmental Impacts).

Chewing gum waste: According to an annual survey, chewing gum is the second most prevalent form of litter in England, making up 26% of litter (INCPEN, 2014). Chewing gum litter is predominantly made up of staining and solid gum, rather than gum wrappers, which account for only 1.3% of all litter (INCPEN, 2014).

The main research on gum as litter comes from organisations concerned with local environmental quality, such as INCPEN and Keep Britain Tidy. The latter found that 95% of Britain's streets are stained by chewing gum. The gum is made from sweetened synthetic rubber and does not biodegrade. It has been estimated by a coalition of councils that each piece of gum costs around 10p to remove (Gammel, 2006). Besides causing the aesthetic blight of a grimy appearance, the gum can adhere to and damage shoes, clothes and hair. Prevalence of littering gum may be related to an apparently widespread attitude that gum (along with dog waste) is not really a type of litter (Brook Lyndhurst, 2012).

Dog waste: While this kind of waste comes low on INCPEN's list of the most frequent kinds of litter, at only 1.3% of litter items in its surveyed sites, it is certainly one of the most noticed and offensive forms of littering, and one of the highest sources complaints to local MPs and councils (Keep Britain Tidy, 2012b).

Dog fouling is both a slip hazard and a potential source of 'toxocara canis' (roundworm) infection. Children between two and four years of age are at the greatest risk of infection because of playing in outdoor spaces and more frequent tumbles and falls. While fewer than ten newly diagnosed cases were reported to the UK Centre for Infections per year (Atensteadt and Jones, 2011), once infected, impacts are significant, ranging from fever to loss of visual acuity (ocular syndrome).

For fear of such consequences, dog excrement may discourage people from using outdoor areas for the purpose of exercise, to the detriment of their physical health (Atensteadt and Jones, 2011).

Drugs-related litter: While a relative newcomer to the UK's litter mix (Philipp, 1993), drugs-related waste has been on the increase since 2001 and is an increasing matter of concern for UK local authorities (Blenkharn, 2008; Blake Stephenson , 2010), reflecting public anxiety about needle stick disease transmission, with children considered to be particularly at risk. This concern caused drugs-related litter to be viewed by the public as "most important for spend" of all types of litter (and irrespective of whether it was actually perceived as a significant problem locally) in a major survey (Keep Britain Tidy, 2009: 18).

Intravenous drug use is widely-known to carry a high risk of hepatitis B, hepatitis C and HIV. Respective rates of infection among those injecting illegal drugs in Montreal, Canada, were found to be 48%, 65% and 16% respectively (Papenburg et al., 2008). Blood-borne viruses have been shown to have the capacity to survive in discarded needles (Thompson et al., 2003; Nyiri et al., 2004), although disease transmission is low: a major study of 'Community-acquired needle stick injury' recorded no incidence of transmission of disease (Papenburg et al., 2008), results that supported many previous smaller studies in Europe, the US and South Africa (Papenburg et al., 2008: 489). The authors nevertheless stress while no incident of transmission arose in their study, the risk remains between 1 and 2% for each virus and there are a number of well-attested cases where infection has been passed on in this way. The main impacts of drug-related litter are the costs of medical investigations as well as the fear induced by needle stick injury, along with a small risk of contracting a life-altering illness.

Environmental impacts

Although somewhat behind other environmental threats such as air pollution and industrial contamination of the ground and water supply, the consequences of littering for the environment are rising up the research agenda. In particular the impacts of litter on marine life are increasingly understood.

Many of the types of litter that originate on land eventually find their way into the water system and seas through processes such as run-off and the sewerage system (MSFD, 2013).

Cigarette-related litter: Cigarette stubs are the most common component of this litter, tending either to accumulate where deposited or to wash through to other areas via gutters, culverts, drainage and sewerage systems. Studies are beginning to show their harmful impact on the environment, including being a source of metal leachate that can cause acute harm to local organisms (Moerman and Potts, 2012). Metals from smoking tobacco such as arsenic, cadmium and toluene get trapped in the filters and then wash into the water system (Smith and Novotny, 2011; Rath et al., 2012).

A study found that just one cigarette stub suspended in a litre of water killed half the fish exposed within (Slaughter et al., 2011). Marah and Novotny (2011) report many other studies that establish cigarette stubs' toxicity.

The cellulose acetate material used to make cigarette filters is non-biodegradable and buoyant, meaning it is easily washed away from the litter source, to become a common source of beach litter – a study by the Ocean Conservancy NGO reports that filters are the most common item found in beach clean-ups each year (cited in Novotny et al., 2009). The accumulated weight of global filters deposited each year has been estimated at over 750,000 metric tonnes (Smith and Novotny, 2011). It therefore comes as something of a surprise that companies are not obligated to use this material: solutions such as biodegradable filters have been piloted and rejected by the industry. Smith and Novotny (2011) note that filters are not the safety measure most smokers assume them to be, and may even be responsible for a rise in certain types of cancer resulting from smoking. Yet they appear to be nothing more than a marketing tool.

Plastics: The most tangible evidence of litter in the oceans is from accumulations of plastics, arriving into the oceans in various and complex ways (Galgani, 2015). It is estimated that between 4.8 and 12.7 million tonnes of plastics enter marine waters annually (Galgani, 2015). Plastics, particularly when eroded to micro particles, can resemble food to sea creatures; their impact on marine organisms includes disruption to the organisms' digestive systems, including plastics' ability to absorb and transport endocrine-disrupting toxins; the accumulation of plastics in organisms; and transfer through the food web.

Accumulation occurs not only in the 'oceanic gyres' or systems of circular ocean currents, which can trap plastics in extensive clusters that show up on satellite imagery, but on the coastal and beach areas where ocean currents deposit their litter loads. At the deep sea level, there is a wide variation between the different oceans of the world, with Indian and Atlantic oceans estimated to have around 500 plastic items on the seabed per km^2, while lower levels are found in the Arctic and Antarctic oceans – one study estimated the former at under 40 items per km^2 (Pham et al., cited in Galgani, 2015). The identification of areas of concentrated litter deposit and perhaps the existence of 'deep sea gyres' is, however, yet to be established. At coastal level, the concentrations are markedly higher, around 725 items per km^2.

Plastics in the seas are gradually broken down due to wind and wave action and interaction with biological organisms, in particular through accumulations of microbes living on their surfaces. Microbes can break down plastics into micro-particles, which can be measured in the sea. At an even smaller level, nano-particles are thought to be pervasive, although there is a need to develop detection methods to improve the evidence in this area (Pham et al., cited in Galgani, 2015).

Plastic debris in the ocean carries broader eco-system risks, through generating 'rafting' opportunities for invasive species, including ones toxic to human health. In terms of marine life, one of the most injurious aspects is through ingestion, particularly of microplastics, which takes place all levels, from that of plankton, though birds and fish species up to marine mammals. The presence of plastics is harmful both due to its adverse impacts on digestion and on the tendency of plastic surfaces to accumulate other chemicals in the seas that disrupt the endocrine system and affect viability of some species' populations (Teuten et al., 2009).

Cotton buds: Evidence is accumulating of the clustering of cotton buds on beach areas, particularly under certain seasonal and tidal conditions (Poeta et al., 2016). These are washed out of the sewerage system where they have been inappropriately disposed. Campaigns to move to biodegradable materials in the stems of such items are gaining ground, as in Johnson & Johnson's recent move to paper stems (Smillie, 2017) but even with paper, rather than plastic, stems, they will still represent another burden on marine areas.

Cumulative impacts

In terms of cumulative impacts, several research studies show links between the deposition of one kind of litter to the accumulation of multiple types of litter and additional 'environmental incivilities' (Ellaway et al., 2009), including fly-tipping, fly-posting, graffiti and vandalism. These problems run along a scale of gravity from creating a visual blight to representing a health hazard and instigating a spiral of decline.

The mechanisms of cumulative impact work in several ways. At the most basic level, litter may attract more litter, a phenomenon that has been described as 'litter-on-litter' syndrome (Cialdini et al., 1990; Krauss et al., 1996). Furthermore vermin and disease may be attracted by litter and rubbish and they may drive people, business and investment away (ODPM, 2002: 11–12; see also Keep Britain Tidy, 2013: 14). As global warming continues, the attested 'urban

heat island effect', whereby high ambient temperatures are both concentrated and prolonged in built-up areas, has the potential to exacerbate litter-origin vermin and disease.

At a higher level is the so-called 'broken windows' effect, which, as its name suggests, pertains to empty and derelict buildings. The theory was introduced by Wilson and Kelling in 1982 and its implications developed by other authors (see for example Cohen, 2000). It proposes that once empty or derelict buildings, litter, fly-tipping and vandalism take hold, they can attract anti-social, illegal and unhealthy behaviours. There is growing research evidence for this connection (Keizer et al., 2008; Brook Lyndhurst, 2012; Keep Britain Tidy, 2014: 27).

More subtly, litter and its attendant 'environmental incivilities' would appear to have a negative impact on people's mental health. Ellaway et al. (2009) found that people who perceived high levels of problems with litter, graffiti, dumped cars/fridges, broken glass, and uneven pavements were more than twice as likely to report frequent anxiety and depression than those who perceived low levels of these problems. Another study has identified a link with people's general sense of security: "Members of the public, who are satisfied with how their area looks, are significantly more likely to be satisfied with how safe they feel in their area" (Keep Britain Tidy, 2009). These negative cumulative impacts of litter do not affect us all in the same way. For example, older people who feel less able to defend themselves and those who spend a lot of time in the local area will be particularly afflicted (Bowling et al., 2006; Mottus et al., 2012).

A final cumulative impact is when the incidence of littering is added to the already-challenging conditions experienced by those living in deprived communities, with lower levels of income, employment and qualifications.

The 2013/14 Local Environmental Quality Survey notes that the percentage of sites with litter levels graded unacceptable increases from 3% in the least deprived to 28% in the most deprived areas (Keep Britain Tidy, 2014). Studies have shown that not only is litter worse in deprived than in better-off areas, but it is perceived to be worse (ENCAMS, 2009; Hastings et al., 2009). Littering may also be of higher concern to people in deprived areas (Burrows and Rhodes, 1998; SDRN, 2004:19).

While it is useful to understand these cumulative impacts, it remains important to distinguish between different types of litter, as each will have different causes and different solutions.

LITTER, SOCIAL PRACTICES AND POLICY IMPLICATIONS

The theory of social practices (Reckwitz, 2002; Shove et al., 2012) has been usefully applied to a wide range of policy issues, from obesity to energy demand. It foregrounds how tightly interwoven our social problems are with our infrastructures, governance and ways of life. In doing so, it points the way to systems-thinking approaches to what changes are needed to shift these problems. The social practices approach indicated in column three of Table 1 raises two important points for this review. First, it makes it clear that the nature of littering is ever-changing and its origins are multiple. It is affected by factors including alterations in lifestyle, in the law, in corporate packaging practice and in digital technologies, working in interaction with each other. Second, the incidence of littering is, in the main part, connected with the life we live on the move, out of doors or in vehicles, whether through choice or obligation (the latter increasingly the case for people who smoke cigarettes or are homeless; but also, as in the case of commuting, influenced by factors as diverse as urban design and housing costs).

With regard to the first point, changing social practices due to new legislation include more smoking out of doors, near offices and leisure venues, based on the indoor smoking ban. This interacts with the corporate packaging decision not to use biodegradable filters, alluded to above, to create a new and significant source of terrestrial and coastal littering.

Corporate packaging decisions affecting littering also include the coastal/marine blight of plastic cotton bud stems, which could helpfully be alleviated by wider adoption of paper stems. But this would not in itself be a problem if some sewerage outlets did not end up in the fluvial and marine system, and if the practice of inappropriate disposal of personal hygiene items in the sewerage system were not widespread.

Similarly, the problem with chewing gum seems to have been made worse by new ways of selling gum without individual foil or paper wrappers for each piece, in combination with the apparently widespread attitude that gum is not really a type of litter. In the case of waste-printed ticketing, technological advances may be expected to alleviate the problem, by issuing digital versions of tickets that create no waste. It should not be forgotten, however, that the increased reliance of electrical devices for all aspects of life has its own non-negligible implications for carbon emissions.

This insight into the highly systemic and interwoven nature of litter causality can be contrasted with policy interventions to combat littering, which, although varied and inventive, are largely based on a linear model of causality, and an implicit 'closed systems' theory of policy impacts, whereby one or more independent variables (corporate practice, individual behaviour, legal penalties etc.) are manipulated to generate positive change in the dependent variable of interest, littering. Social systems are, however, open and complex systems where changes to any element have multifarious downstream effects, some of which are predictable, some of which are not.

Most literature on littering shows some recognition of the range of agents that play a role in creating and alleviating the problem, ranging from individuals to communities, retailers, NGOs, local authorities, law courts and up to multinational corporations and governments (Brooks and Davoudi, 2013). Each nation appears to target its anti-littering interventions to a particular set of actors. In current UK policy, there is a strong emphasis on getting individuals to take responsibility for their anti-social behaviour in creating the blight and to change their behaviour, for example, through fixed-penalty notices and Community Protection Notices (CPNs), while in countries such as France and Australia, there is greater pressure on industry to develop more environmentally friendly packaging, through legislative and advisory means.

The review of Local Environmental Quality from which this paper draws (Davoudi and Brooks, 2012) gives referenced examples of many such interventions along the continuum of responsibility. Showing the limitations of the 'linear' policy approach, many such strategies, including the campaign accompanying the indoor smoking ban mentioned earlier, and the Australian Packaging Covenant (APC, 2015; APC 2017), have been shown to exhibit short-term success and long-term plateauing or retrenchment.

In contrast to the linear approach, a 'systems thinking' approach would suggest at the very least joining up policies on waste with those promoting environmental awareness and behaviours, to all agents from corporations and governments down to individuals. Littering mitigation then becomes a part of a move towards a 'greener' social policy that supports organisations and people to show their care for where they live by investing in the quality of their local environment. They can bring this about not just by taking actions to alleviate littering, but by joining in efforts to maintain local and wider environments as places that are healthy for people and for wildlife. A useful by-product of this approach is that it can then give greater prominence to environmental issues that are currently 'out of sight and out of mind' such as marine littering.

With regard to the second insight of the social practices approach, that littering is a consequence of the life lived out of doors, a helpful link can be made here with the main demographic attributes associated with littering – youth and low income (Davoudi and Brooks, 2012). In terms of resources and the relative impacts of penalties, these are groups that can safely be described as vulnerable. They are also a group less likely to have private transport options, at least as regards the vast majority of the population who live in urban or peri-urban areas. The people who throw litter from a vehicle are usually far away from the scene before their offence can be noticed or recorded. It is those who go on foot who are most likely to be observed in the act of littering and issued with fixed penalty notices and CPNs.

In this regard, there is much to be gained by linking the policies that punish littering and resource environmental cleansing with the social justice dimension that is operative in many other policy areas. At their worst, by penalising the weakest actors in the littering spectrum with regressive fines such as fixed-penalty notices and by placing them in the ambit of the criminal justice system through CPNs (breach of which can be a criminal offence) current policies have the potential to further marginalise the vulnerable groups most likely to litter and beyond this, may bring even bring into question the fairness of the justice system.

The polarisation of wealth that is occurring across Europe and the US looks unlikely to diminish in the short term, as jobs continue to be removed from the economy through digitisation and the excess pool of labour allows continued casualisation of employment through such means as zero-hour contracts and 'contractor' business models such as that of Uber. Whatever the pressures on funding-squeezed authorities to raise revenues to support compliance with environmental legislation, the association between youth, low income and littering behaviour argues against blanket penalties such as fixed-penalty notices. It also argues for increased sensitivity in campaign message design, so that exhortations to take responsibility for the quality of the local environment do not result in further stigmatisation of heavily littered areas (likely to be deprived communities) as places where 'they do not care'.

This article has presented no more than a glancing consideration of the potential of one contemporary theory of social change, the social practices theory, to shed light on some directions in which policy might be developed to better address causes and remedies for littering. The intention is, through indicating the value of applying social change theories to this area of policy, to stimulate further contributions in the field.

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